Why CORE Works

More and more educators are asking the question, "How can technology be integrated into the classroom?" This question is asked because of the mounting evidence that today's students, those born after 1982, have a different relationship with information and learning than previous generations as a result of their access to the Internet and other enabled technologies (Diana Oblinger, Vice President for EDUCAUSE; 22nd Annual Conference on Distance Teaching and Learning; Board of Regents of University of Wisconsin System). Until approximately thirty years ago, teaching had not been studied in a truly scientific manner. In the 1970's, researchers began to study the effects of instruction on student learning. Today, even more studies are done on increasing student achievement. This paper reflects the findings of Robert J. Marzano, Debra J. Pickering, and Jane Pollock in *A Theory- Based Meta Analysis of Research on Instruction*. In this book, Robert J. Marzano analyzed more than 100 research reports on instruction, involving more than 1.2 million subjects. The goal of this study was to identify those instructional strategies that have a high probability of enhancing student achievement for all students in all subjects and grade levels. Based on this study, nine categories of instructional strategies were identified as most likely to enhance student achievement. Not only are many teachers using these strategies, but they are asking how technology can be integrated with these strategies to increase student achievement.

In this article, we review the research of Robert J. Marzano, Debra J. Pickering, and Jane Pollock while giving concrete examples of why CORE, Curriculum Online Resource for Educators, supports this well-known study. CORE incorporates and refines research-based educational practices that help teachers provide interesting and challenging instruction to 21st century learners.

Meta Analysis Study

The primary goal of Robert J. Marzano's study was to identify the instructional strategies that increase and enhance student achievement. Figure 1 is a representation of the nine categories found to have a strong effect on student achievement.

Figure 1: Categories of Instructional Strategies That Affect Student Achievement

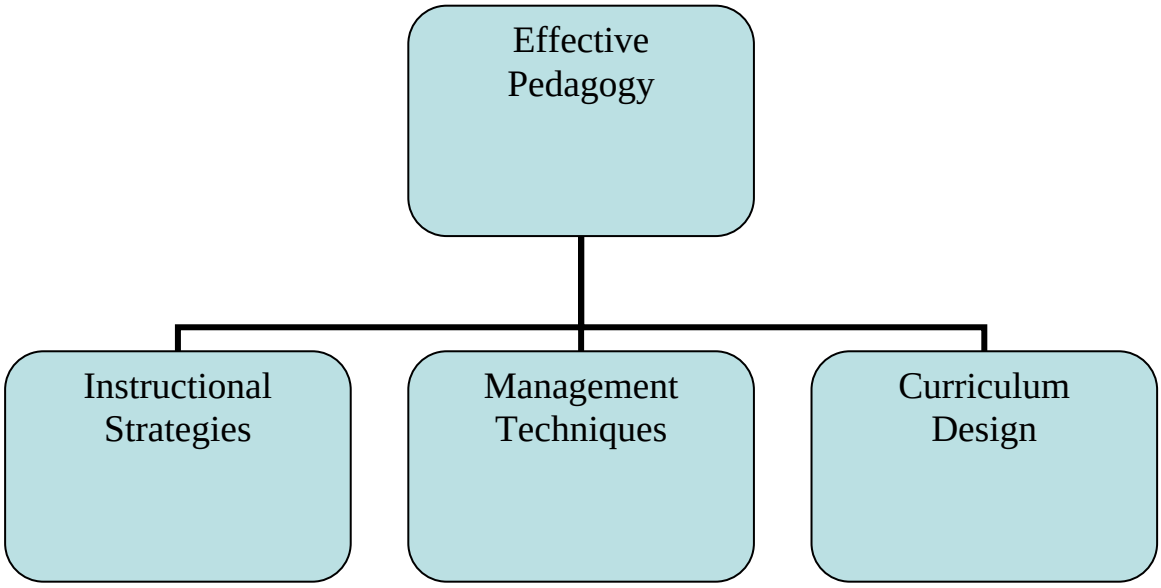
Category	Ave. Effect Size	Percentile Gain	No. of ESs	Standard Deviation (SD)
Identifying Similarities and Differences	1.61	45	31	.31
Summarizing and Note Taking	1.00	34	179	.50
Reinforcing Effort and Providing Recognition	.80	29	21	.35
Homework and Practice	.77	28	134	.36
Nonlinguistic Representations	.75	27	246	.40
Cooperative Learning	.73	27	122	.40
Setting Objectives and Providing Feedback	.61	23	408	.28
Generating and Testing Hypotheses	.61	23	408	.28
Questions, Cues, and Advance Organizers	.59	22	1.251	.26

(Marzano, 1998, p. 7)

From this figure, an inference can be drawn that no instructional strategy works equally well in all situations; just as all students learn at various levels. Any combination of these strategies helps promote differentiated instruction and enhance student achievement.

Another idea to note from Marzano's article is that instructional strategies are only one aspect of classroom pedagogy that affects student achievement. Marzano states that "effective pedagogy involved three related areas: the instructional strategies used by the teacher, the management techniques used by the teacher, and the curriculum designed by the teacher." (Refer to Figure 2.)

Figure 2: Three Elements of Effective Pedagogy



(Marzano, 1998, p. 10)

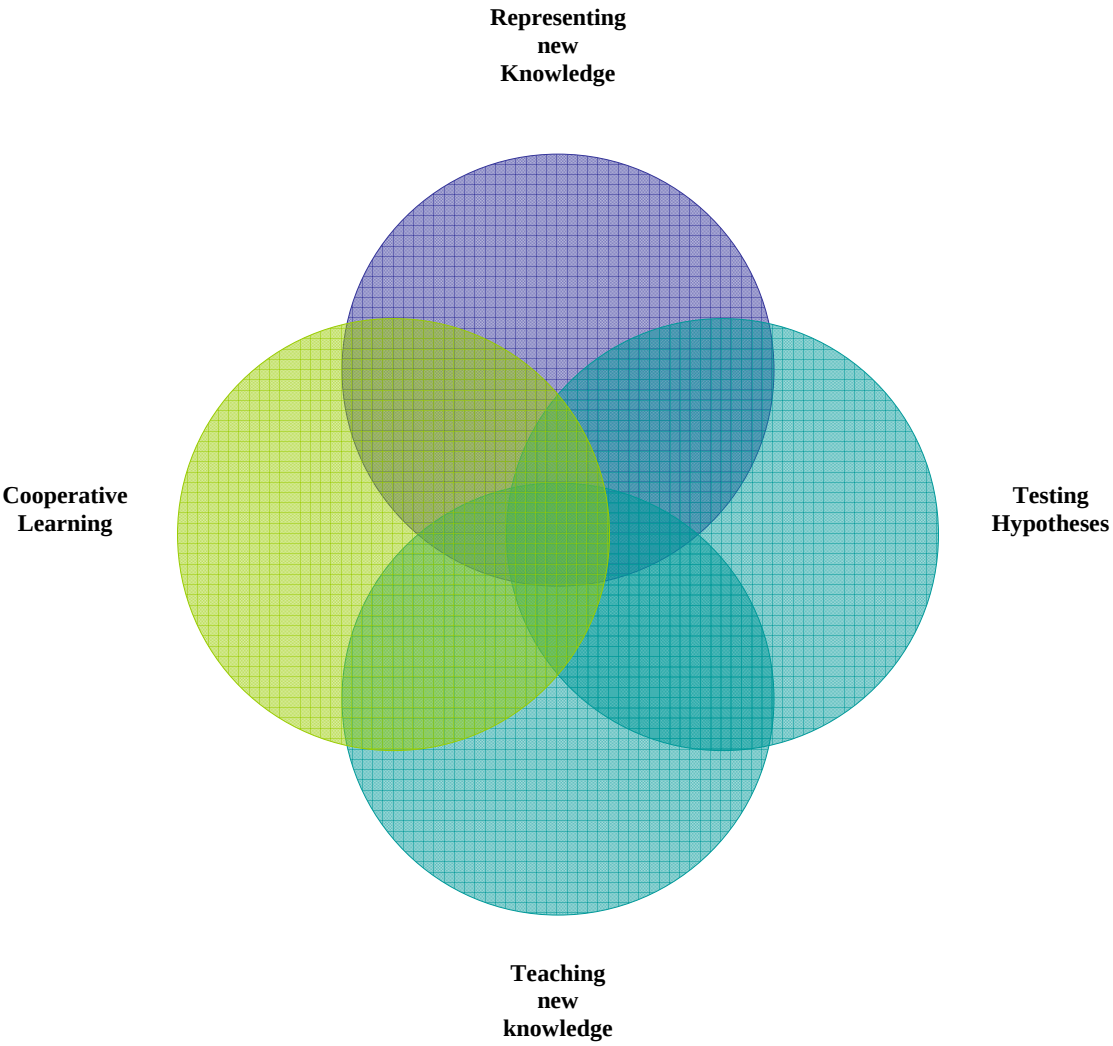
As stated, any combination of instructional strategies paired with management techniques and curriculum design produces effective ways to enhance student achievement. This article will address instructional strategies and curriculum design. The first topic addressed is instructional strategies, followed by examples of how CORE addresses these strategies.

The four instructional strategies discussed in this article will include:

1. Representing new knowledge in graphic/nonlinguistic formats
2. Cooperative Learning
3. Generating and testing hypotheses about new knowledge
4. Direct presentation of new knowledge, followed by application

You will also be provided with examples of how technology, in this instance CORE, supports these strategies. (Refer to Figure 3 for further examples.)

Figure 3: Instructional Techniques Reviewed



These instructional techniques have been proven through meta-analysis (combining the results from a number of studies to determine the effect of a given technique) to have an effect size greater than 1. These results indicate that the average student who benefited from these instructional techniques outscored more than 84% of students in control groups.

Representing New Knowledge in Graphic/Nonlinguistic Formats

Research in cognitive psychology indicates that our brains store knowledge using both words and images. Instruction that targets and engages both of these system representations has been shown to significantly increase students' comprehension and retention. Explicitly engaging a student in the creation and usage of nonlinguistic representations has been shown to stimulate and increase activity in the brain (Marzano, 1998), hence engaging the 21st century learner.

Educational Tools acknowledges the importance of instruction that targets and engages the student using both words and images. Nonlinguistic representations of knowledge can take a variety of forms, including graphic representations, physical models, mental pictures, drawings, and kinesthetic classroom activities (Learning and Leading Technology, p. 7). There are several studies that indicate these types of activities help enhance students' understanding of content. These activities can include: creating graphic representations, making physical models, generating mental pictures, drawing pictures and pictographs, and engaging in kinesthetic activity (Marzano, 1998, p. 73-74).

Throughout CORE's online curriculum, educators will find a library of activities in nonlinguistic format. One example is when a student is expected to learn fractions and understand that ½ and 2/4 are equal. To address this concept, CORE delivers curriculum in a multitude of formats, including exploration activities where the student may draw or create fractions with different learning tools such as clay, paper, and art or engage in a kinesthetic activity. Most children discover that engaging in these kinds of activities is a fun and enjoyable way to learn. Teachers can utilize a variety of strategies when using the nonlinguistic approach, which promotes differentiated instruction. CORE's curriculum addresses the need for differentiated instruction by providing an array of challenging and engaging activities to enhance the learning of any student.

Cooperative Learning

Another powerful instructional strategy is grouping students for learning activities. Teachers can group students for a particular lab or activity or arrange students in groups for a longer period of time to conduct a study or entertain a more long term project. According to David Johnson and Roger Johnson (1999), there are five defining elements of cooperation:

- ☆ Positive interdependence (a sense of sink or swim together)
- ☆ Face to face promotive interaction (helping each other learn, applauding success and efforts)
- ☆ Individual and group accountability (each of us has to contribute to the group achieving its goals)
- ☆ Interpersonal and small group skills (communication, trust, leadership, decision making, and conflict resolution)

- ☆ Group Processing (reflecting on how well the team is functioning and how to function even better)

(Marzano, 1998, p. 90)

Cooperative learning is both a flexible and powerful approach to teaching. Educators can use cooperative learning to engage students and enhance student learning in many different scenarios. The Hands-On Activities, Assessment Questions, and instructional methods in CORE are all different ways teachers can apply cooperative learning strategies in the classroom. For example, one of the CORE labs focusing on Conductors and Insulators allows students to be grouped together for a lab or activity and then return back to individual learning when they answer the conclusion questions at the end of the lab. A more long term example of grouping using CORE would be having the teacher introduce a topic such as Electricity. The teacher could download a song and then divide the class into cooperative learning groups for a unit about Electricity. Each day, the teacher could choose a Writing Prompt, Assessment Question, Video, or Reading Passage for students in the group to explore electricity together.

Generating and Testing Hypotheses about New Knowledge

This strategy is another effective way of teaching. It requires students to apply their knowledge and deepen their understanding of a topic. Generating and testing hypotheses is actually something we all do quite naturally. Generating and testing hypotheses can be approached in a deductive or inductive manner. Deductive thinking is the process of using a general rule to make a prediction about a future action or event. The following examples of deductive and inductive thinking are from Robert J. Marzano's *Classroom Instruction that Works*:

Inductive thinking is the process of drawing new conclusions based on information we know or of which we are presented. If you are reading an account of how a particular bear behaved when being observed by a scientist, you would induce that the behaviors the scientist had frequently observed are behaviors the bear habitually engage in. Inductive instructional techniques require students to first discover the principles from which hypotheses are generated.

In the classroom, teachers should ask students to clearly explain both their hypotheses and conclusions; preferably in writing. The process of writing and explaining their understanding will help the student deepen their understanding of the concept.

In an inductive approach, the teacher may ask:

1. Explain the logic underlying your observations
2. How do your observations support your hypothesis?
3. Why does your hypothesis make good sense?
4. How does your experiment test your hypothesis?
5. How do the results confirm or disconfirm your hypothesis?

> Rather, if the deductive technique was used, students would not be involved in this process. (Marzano, 1998, p.105)

Many times the process of generating and testing hypotheses is used with the scientific method, which is commonly applied in many school settings. Teachers should assemble curriculum so that students know what they must accomplish. Examples of this may be:

- ☆ Provide students with templates for reporting their work
- ☆ Provide sentence stems for students to help them articulate their explanations
- ☆ Provide or develop rubrics with students so they know the criteria of which they will be evaluated with

Several processes encourage students to generate and test hypotheses, including systems analysis, invention, experimental inquiry, decision making, and problem solving. CORE incorporates each of these systems in challenging, unique assignments that are 100% aligned to state standards through Inquiry-based Labs, problem solving questions and activities, and invention projects.

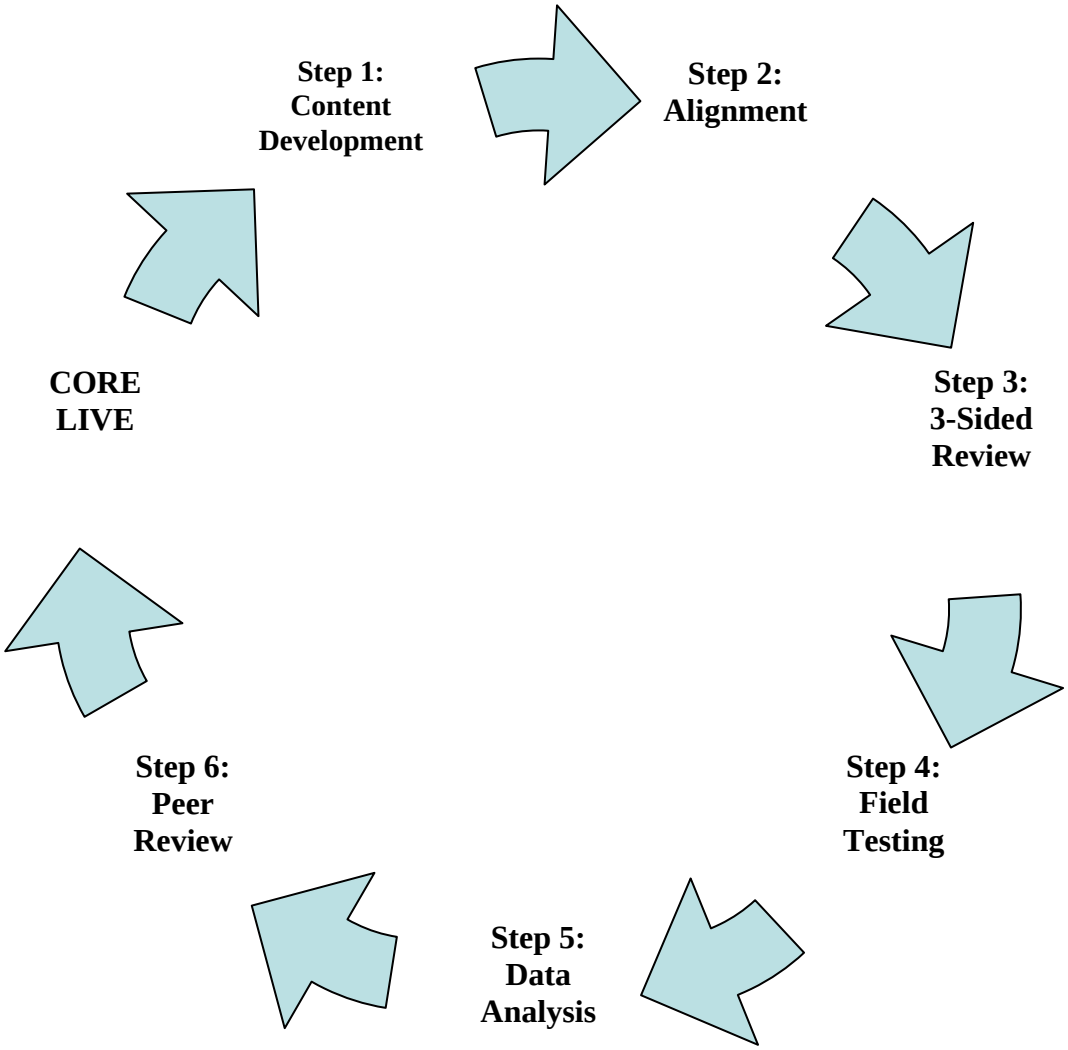
Direct presentation of new knowledge, followed by application

As the Marzano (1998) meta-analysis study notes, "students learn effectively and efficiently when they are first taught new conceptual categories, generalizations, and principals directly, and only after which they apply on their own. Ideally, then, educational software should support this instructional sequence by serving two main objectives: first, it should support teachers in supporting new knowledge to students, and second, it should support students in applying and extending what they have learned on a more individual basis."

Until recently, most educational software has been created specifically for the student where there is no specific role for the teacher. This type of technology is more difficult for an educator to easily implement into existing curriculum. These products do not provide any kind of support for the educator when introducing new topics or trying to engage students. Today, educators are looking for an all inclusive approach that can be integrated into any curriculum and engages the needs of the 21st century learner.

CORE provides teachers with more collaborative learning approaches and greater flexibility; the curriculum includes model lesson plans that include all students with different learning styles and ability levels. The teacher can apply this differentiated approach by having the students complete a Warm-Up Activity, download a video to watch, or engage in a hands-on activity to introduce a new topic. Not only does CORE include activities, assessments, reading passages, and instructional media to promote differentiated instruction, it also provides opportunities for the teacher to connect with over 10,000 science educators and experts across the country. The peer connection section of CORE is extremely powerful because it connects educators with experts across the country to discuss how to introduce new topics, engage students, share new ideas for lesson plans, and much more.

To reiterate the three elements of effective pedagogy when striving to increase student achievement, it is important to discuss the instructional design of CORE. CORE was comprised during a seven step process of:



Instructional design is the practice of arranging content to help learners and teachers transfer knowledge most effectively. CORE was developed by our dynamic team of over fifty master level authors. The content development team identified and employed teaching strategies and techniques from years of classroom experience to deliver the best curriculum content. Then CORE was tested to meet state alignment standards, reviewed for readability, grade level appropriateness, and authenticity; it was field tested by a variety of schools, teachers, and students. Data analyzed from the field testing concluded that the curriculum implemented through CORE meets the needs of the 21st century educator and includes an array of instructional strategies to enhance student achievement.

Finally, CORE underwent a peer review which acted as a bridge to completing the only all-inclusive online curriculum program for educators.

Robert J. Marzano's meta-analysis research on instructional strategies has identified scientific evidence that proves instructional techniques found in CORE, Curriculum Online Resource for Educators, significantly improve student achievement. Educational Tools has created an innovative program to address the fundamental needs of today's schools. CORE is based on years of research and proven instructional formats, as well as input from thousands of educators. CORE saves valuable instruction time by providing targeted activities with proven instructional strategies that are 100% aligned to state standards. The instructional design of CORE is poised to meet the challenges of the 21st century educator while delivering curriculum to promote differentiated instruction.

For additional information on Educational Tools research based practices, please contact the Department of Curriculum Development at Educational Tools, Inc.

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